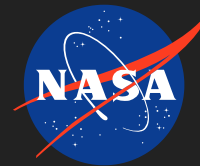


A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II

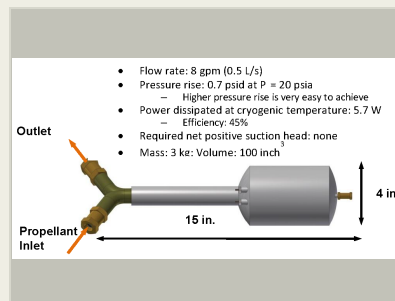
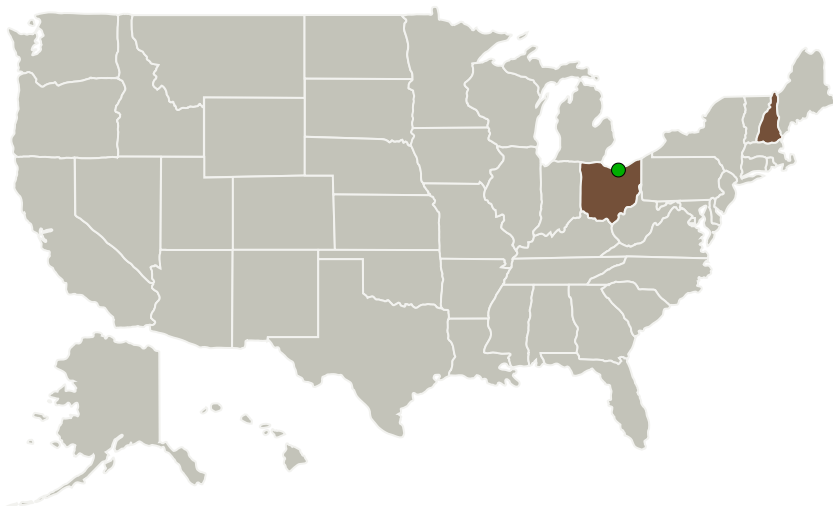
Completed Technology Project (2014 - 2016)



Project Introduction

Refueling spacecraft in space offers tremendous benefits for increased spacecraft payload capacity and reduced launch cost. However, there are several key challenges with space refueling associated with the storage and handling of liquid cryogenics in space. To meet these challenges, we propose to develop a reliable, compact, efficient cryogenic mixing pump with no moving parts. The mixing pump will prevent thermal stratification of the cryogen and simplify pressure control for storage tanks. The mixing pump uses an innovative thermodynamic process to generate fluid jets to promote fluid mixing, eliminating the need for mechanical pumps. Our innovative mechanism will be able to self-prime and generate a high-pressure rise. The device will significantly enhance the reliability of pressure control systems for storage tanks. In Phase I, we demonstrated the feasibility of our approach through building and testing a proof-of-concept mixing pump, optimizing the mixing pump design by analysis, and developing a preliminary layout design of a prototype pump. In Phase II, we will build and test a laboratory-scale cryogenic mixing pump, demonstrate its performance in a representative cryogenic environment, and deliver the pump to a NASA research lab for further evaluation.

Primary U.S. Work Locations and Key Partners



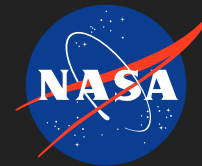
A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II

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A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II

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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

New Hampshire	Ohio
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Project Transitions

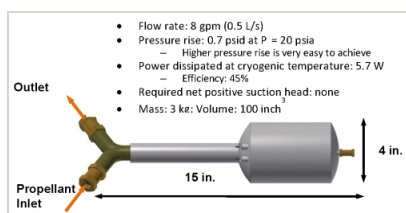
▶ **April 2014:** Project Start

✓ **October 2016:** Closed out

Closeout Documentation:

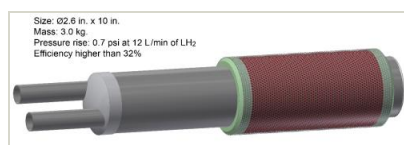
- Final Summary Chart(<https://techport.nasa.gov/file/137631>)

Images



Briefing Chart Image

A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II
(<https://techport.nasa.gov/image/131286>)



Final Summary Chart Image

A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II Project Image
(<https://techport.nasa.gov/image/132503>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Weibo Chen

Co-Investigator:

Weibo Chen

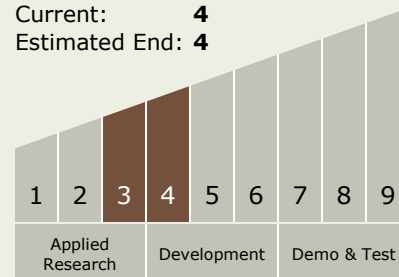
A Reliable, Efficient Cryogenic Propellant Mixing Pump With No Moving Parts, Phase II

Completed Technology Project (2014 - 2016)



Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.1 In-space Propellant Storage & Utilization

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System